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OPPORTUNITIES, CHALLENGES AND CURRENT PROGRESS WITH DEVELOPING WOODY BIOMASS FUELS APPLICATION IN MONTENEGRO

Abstract: This paper presents the research results on technically available amounts of wood residue from forestry and wood processing which can be put in function for wood fuels production as well as the model of efficient usage of woody biomass in future in Montenegro.

Key words: *wood, residue, energy, model*

Sažetak: U radu su prikazani rezultati istraživanja tehnički raspoloživog drvnog ostatka iz šumarstva i prerade drveta koji se mogu staviti u funkciju proizvodnje drvnih goriva kao i model za efikasnije korišćenje drvne biomase u Crnoj Gori u bliskoj budućnosti.

Ključne reči: *drvo, drvni ostatak, energija, model*

INTRODUCTION

Montenegro is the only country in South East European region with potentials for using wood residue for the purposes of producing modern wood fuels (i. e. beyond the traditional market for firewood for domestic heating) where these potentials are not used at all or are used to an extremely small degree. This statement especially refers to forestry sector where significant amounts of wood residue appear in the process of logging and wood assortment production.

The given statement is a general mark which is present in several studies and reports done in Montenegro in the last several years which were ordered by domestic institutions or international organizations [1,8,10,12]. Here, all those documents researched woody biomass potentials and thus wood residue potentials from forestry and wood processing taking into consideration their maximum possible values without getting deeper into the problem area of actually available amounts from technical, economic and environmental aspects. Also, these documents did not in-

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clude any research results of market advantages and potentials for using wood residue for the needs of energetic systems and wood fuels production.

SCOPE AND OBJECTIVE OF THE PAPER

Starting from the previously stated facts, the need to conduct more detailed researches emerged both in the segment of actually available amounts of wood residue for wood fuels production and in the segment of market potentials and advantages for their utilization in different energetic systems. In that sense the main objectives of the paper are:

– Identify any already existing users of woody biomass from Montenegro's forests,

– Research and present actually available amounts of wood residue from forestry and wood processing which can be mobilized for energy production for the needs of energetic systems outside these two sectors,

– Review existing Project Documents and more specific studies conducted by international and domestic organizations and agencies relating to the installation of new/refurbishment of existing heating systems where wood could be considered as an option as a fuel,

– Collect accurate information about the scale of energy needs for forthcoming projects (possibilities of using wood fuels for the needs of heating public facilities in Montenegro in near future)

Beside the abovementioned, additional reason for doing these researches is the need to investigate and observe the current situation and trends in the production and on the market of wood fuels in Montenegro.

Time period covered in the researches referred to the years 2008–2010 and as such it represents sufficiently long period for making analyses and defining adequate conclusions.

METHOD OF WORK

Methodology is defined according to the research objectives and the main purpose of the paper. As general scientific methods, historical method was used as well as the methods of analysis, synthesis, induction and deduction. Historical method was used in the part where the development of fuelwood consumption was represented. Methods of analysis and synthesis were used to research the markets of wood fuels in Montenegro, while the methods of induction and deduction were used for drawing adequate conclusions on market potentials. Generalization method was used for deriving general conclusions based on individual observations in the part of the paper.

Questionnaire method was used for the purpose of surveying producers of wood fuels in Montenegro. During field research, numerous interviews were done in the forestry and wood working companies as producers of the wood fuels. In that sense three different questionnaires were made based on which interviews were done and necessary information and data were collected.

Data from reports and publications of official institutions, Forest Directorate of the Ministry of Agriculture, Forestry and Water Management of Montenegro, data from wood processing companies, publicly available documents and strategies connected with energy sector in Montenegro as well as data and information obtained in the process of field researches and visits to the companies and other stakeholders were used for the requirements of this paper.

Due to all abovementioned, the analyses made and data summed give uniqueness to this paper through the overview of the current situation and conclusions and at the same time, professional and scientific public obtains a lot of useful information.

FUELWOOD AND WOOD RESIDUE IN FORESTRY AND WOOD PROCESSING: AMOUNTS, ENERGY VALUE AND OPPORTUNITIES FOR COMMERCIAL USAGE

For observing the amounts and energy value of wood residue from forestry sector it can be started from the analysis of potentials or from the analysis of results and parameters realized in practice. Both ways have their advantages and disadvantages. Analysis of potentials shows opportunities for using woody biomass which are, almost as a rule, rarely fully realized in practice for numerous reasons. However, this type of analysis is useful for creating policy and defining the measures to be undertaken in order to realize potentials in as high degree as possible. Also, potentials of woody biomass are often used for the purpose of comparison with other renewable sources and thus observing its position, role and significance.

Analysis of indicators and parameters realized in practice is useful for obtaining insight into actually available amounts, especially in the short term, which can be immediately used for energy production.

For analyzing available amounts and energy value of wood residue from forestry sector in Montenegro, the starting point was the planned annual allowable cut and planned percentage of utilization of wood raw material during logging and wood assortment production. For that purpose, plan documentation of Montenegro Forest Authority defined annual allowable cut in the amount of 717,568 m^3 gross wood volume [3]. According to the same documents, planned percentage of wood residue from logging and wood assortment production in the forest is 20% for coniferous and 19% for broadleaves (characteristics of stands, wood species, quality of habitats and other parameters are taken into consideration). Also, the fact that it is not possible to use all wood residue and use it for energy production is taken into consideration because a) in certain areas its collection and drawing out is not economically viable and b) after the process of wood assortment production is completed a certain amount of woody biomass is lost through deterioration over time. For calculations in this paper, results of field researches done in south west part of Serbia on coniferous and broadleaves stands are used, which were done for the needs of one study that referred to the opportunities for using woody biomass

for the needs of energy production for heating public facilities in that region. According to the results of the abovementioned Study, 10–11% of wood residue in the forest can actually be used for energy compared to its total planned amount.

Based on the realized logging volume in 2008, technically available amount of wood residue from forestry sector which can be used for energy production was 58,306 m^3, and its energy value at the adopted parameters (moisture content and wood species) was 126,673 MWh (table 1). The stated amounts and energy value are actually available amounts, which is significant for the process of producing energy balances in the sense of balancing energy from different sources. For the reason stated in the following, and for the needs of this paper, amounts and energy value of wood residue from forestry sector which is actually available for energy purposes in Montenegro are used.

For observing the situation regarding the amounts and consumption of wood residue from sawmill wood processing in Montenegro, it is necessary to start from the available data on recorded logging and structure of the produced forest assortments, their foreign trade and consumption. In that sense, for the needs of analyses in this report, 2008 was selected as reference year because 2009 was highly unfavorable for most wood processing companies in Montenegro due to the effects of global economic crisis. In 2008, total consumption of industrial and technical wood in Montenegro was 328,857 m^3 (net mass) out of which 274,993 m^3 was coniferous and 53,864 m^3 was broadleaves assortments [calculations based on 2, 3, 4, 7].

Beside the data on size and structure of wood residue, Table 2 also gives the data on its energy value separately for primary and final wood processing. For calculating energy value of wood residue in primary wood processing minimum energy value 1 solid wood m^3 of coniferous and broadleaves wood residue at moisture content of 40% is adopted, and for energy value od wood residue in final wood processing at moisture content of 12%. Adopted values of wood residue moisture content are most often present in practice, which means that there are examples of significantly lower as well as of somewhat higher moisture content of wood residue that can be found in companies.

Apart from this, it is necessary to state that the abovementioned amounts and values given in Table 2 are minimal, which is in accordance with the adopted approach in this paper to research and analyze amounts actually available for consumption for energy purposes not taking into consideration potentially bigger amounts and values which certainly exist but are not used yet due to various reasons.

Significant amounts of wood residue from the process of logging and wood assortment production remain and decay in forests. The situation is the same with wood residue from wood processing, especially in sawmills, which is disposed of on waste disposal areas near the factories or is burnt. In that sense, there are several black spots (locations) in Montenegro which represent a serious environmental problem because the amounts of wood residue (mostly sawdust). They are so big

that significant financial resources will be needed for their cleaning as well as efforts of the Government and local self-governments.

Collective data presented in Tables 1 and 2 show that it is possible to produce about 414.4 thousand MWh (414 GWh) of energy from the available wood residue in Montenegro. Compared to the realized production of electric power of 1,206 GWh in 2008 [9], it represents 34.4%, which surely cannot be disregarded as Montenegro imports significant amounts of electric power and other fuels. Putting in function and the realization of available amounts of woody biomass for energy purposes will give significant contribution to the reduction of energetic dependence of Montenegro.

Current situation regarding the usage of fuelwood in Montenegro

Fuelwood is traditionally the main fuel used for the purposes of heating and preparing food in households in rural as well as numerous urban areas. According to the conducted researches, fuelwood is the dominant fuel for heating households in rural and urban households in north Montenegro. Apart from this, fuelwood is used in large amounts in Podgorica, Danilovgrad and Nikšić as well.

Fuelwood market is characterized by the offer of two main assortments, namely one-meter log woods and chopped log woods. The second important characteristic of fuelwood market is the fact that households are supplied in three ways: from own forests (for households which possess forests), by procuring from private forest owners and purchasing from entrepreneurs and companies in wood processing [5].

Table 1. Available amounts and energy values of wood residue from forestry based on realized logging volume in Montenegro in 2008

Ownership	Realized logging volume* in gross amount (m^3)		Technically available wood residue for energy production m^3		Amount of wood chips which can be produced based on technically available wood residue in loose m^3		Amount of energy based on the possible amount of wood chips in MWh		
	Coniferous	Non-coniferous	Coniferous	Non-coniferous	Coniferous	Non-coniferous	Coniferous	Non-coniferous	Total
State forests	260,393	141,795	26,039	13,471	65,097	33,677	49,083	35,193	84,276
Private forests	92,213	100,794	9,221	9,575	23,053	23,938	17,382	25,015	42,397
Total	352,606	242,589	35,260	23,046	88,150	57,615	66,465	60,208	126,673

Sources: Felling in 2008., MONSTAT; 2. Forest Directorate

Energy density of wood chips in kWh per loose m^3 (Moisture=40%): coniferous (spruce)=733 kWh, non-coniferous (beech) =1,015 kWh

* Realized logging volume is gross wood volume which is recorded as logged wood.

Table 2. Consumption of industrial and technical roundwood in primary wood processing in Montenegro and structure and amount of wood residue and its energy value

Realized consumption of industrial and technical wood in 2008 (netto m^3)		Structure and amount of wood residue in primary wood processing for the realized volume of industrial and technical wood processing in m^3				Total wood residue in primary wood processing in m^3	Amount of energy based on the available amount of wood residue from primary wood processing in MWh	Total wood residue in final wood processing in m^3	Amount of energy from final wood processing in MWh*	Total amount of energy from primary and final wood processing in MWh
		Coniferous		Non-coniferous						
Coniferous	Non-coniferous	Large residue in m^3	Small residue in m^3	Large residue in m^3	Small residue in m^3					
274,993	53,864	60,498	35,379	14,004	10,232	120,113	236,902	19,853	50,819	287,721

* Calculated based on cca 20,000 m^3 of residues from processing of 30,000 m^3 of lumber in 2008. Sources: 1. Felling in 2008., MONSTAT; 2. Forest Directorate, 3. Author's calculations

Note 1. Percentage of utilisation of coniferous and broadleaves roundwood and the structure of participation of large and small residue from industrial wood processing obtained from companies during field researches for the needs of this Report and as such represent average values.

Note 2: Energy density of wood residues in kWh per m^3: (Moisture=40%): 1 m^3 solid wood coniferous= 1,829 kWh, 1 m^3 solid wood non-coniferous= 2,538 kWh; (Moisture 12%): 1 m^3 solid wood coniferous= 2,093 kWh, 1 m^3 solid wood non-coniferous= 3,025 kWh

Note 3. For the calculation of wood residue from final wood processing, the example of finalization of 7,200 m^3 of beech sawn wood into mechanically processed elements for furniture in Serbian companies was taken. Out of the initial 7,200 m^3 of sawn wood in the first phase 3,024 m^3 of roughly processed furniture elements is obtained as well as 720 m^3 of strips for parquet. Out of 3,024 m^3 of roughly processed elements in the second phase of processing 1,890 m^3 of mechanically processed elements is obtained from which final products (furniture) are obtained in further phases of technological process. Compared to the innitial amount of sawn wood (7,200 m^3) its total utilization is 36.25% or 1,890 m^3 + 720=2,610 m^3.

According to the official statistics, fuelwood production was 156,181 m^3 in Montenegro in 2008, out of which 148,076 m^3 were broadleaves and 8,105 m^3 were coniferous. In the same year, fuelwood consumption was 150,651 m^3 [2].

For the needs of heating permanently inhabited apartments in Montenegro in 2008, the most common fuel was electric power with the participation of 44%. Fuelwood was second important fuel with the participation of 35.9% while other fuels are far below electric power and fuelwood [graph 1].

Based on the results of the calculation of fuelwood consumption in 2008 and the registered export and import, total production of this wood assortment was 260,474 m^3 and compared to the statistically recorded production (156,181 m^3) it was higher by 104,293 m^3. Incomplete statistical recording of realized loggings in private forests is one of the reasons why there are differences between statistically recorded and actual production of fuelwood [5].

Analysis of the total logged wood in 2008 which is statistically recorded and the difference in fuelwood production shows that total volume of realized loggings in 2008 was within the limits of planned annual allowable cut, which is significant from the aspect of sustainable forest management. Even beside the differences in the amount of produced fuelwood, this principle in forestry is not impaired. How-

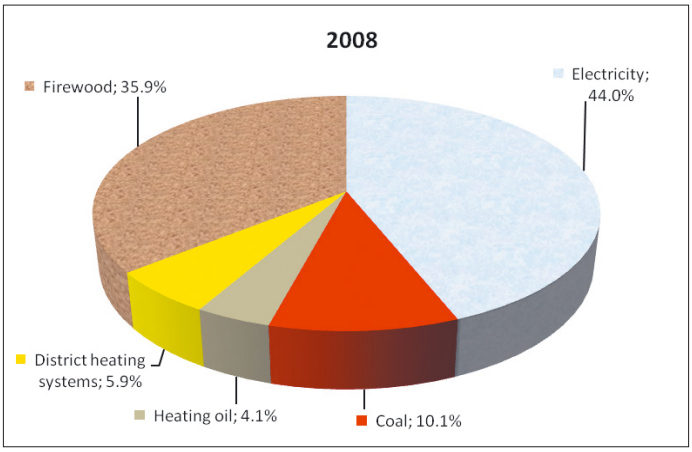

Figure 1. Participation of certain fuels for heating permanently inhabited apartments in Montenegro in 2008 [5]

ever, distribution of the harvesting intensity evenly throughout the forest is not assured, and therefore sustainability is not guaranteed on the local level.

The process of reconstructing public facilities (schools, hospitals, health care centers, Government buildings and other) implemented through several credit lines (from KfW and World Bank) used by the Government of Montenegro is an initial opportunity to start using woody biomass as fuel for the purpose of heating these facilities. Additional reason for this is that special highlight is on the conversion of fossil fuels to woody biomass fuels in these facilities. Also, the project for reconstructing district heating system in Pljevlja is in the final phase where the conversion from coal to woody biomass fuels is planned, which is also an important chance for accelerated development of the market of these fuels [5].

Readiness of certain owners of wood processing companies to find strategic partners and more serious thinking that it is high time to start with wood fuel production are an opportunity for market development of these fuels. This chance is increased by the existing legislation which conditions the issuing of construction permits for new structures with the term that at least 20% of energy for the needs of those structures has to be from renewable energy sources [6,13].

Announcements from certain government institutions that soon a package of regulations with support measures for producers and consumers in the form of incentives will be adopted are an additional element of opportunities for accelerated development of wood fuel market in near future.

MODEL OF EFFICIENT USAGE OF WOOD RESIDUE IN FUTURE IN MONTENEGRO

Based on the available woody biomass potentials, a model of its efficient usage has been defined with three zones where the production of wood based energy

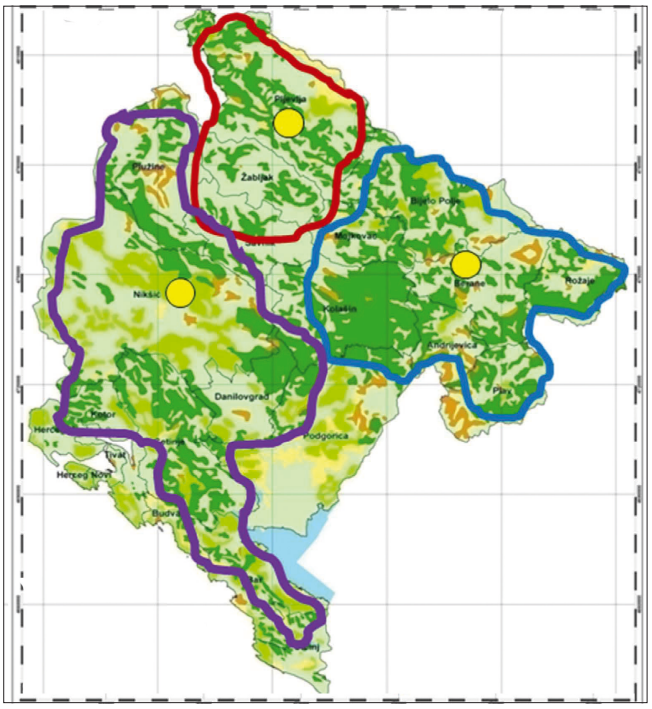

Figure 2. Model of efficient usage of wood residue in Montenegro [5,11]

would be located (picture 1). In zone one in Pljevlja wood chips and wood pellets production would be situated, in zone two in Berane wood chips production and cogenerating plant and in zone three in Nikšić chips and wood pellets production would be situated. The abovementioned centers would include the supply of wood residue from the places around these centers, by which the entire territory of Montenegro would be covered.

Such a model is the result of not only raw material potentials but of the existing capacities for wood processing and already started activities by certain companies as well.

Proposed model results from the consultations done with the companies which are the biggest wood processors in these regions and which have expressed their readiness to start with the activities on practical implementation of wood fuel production and supply to consumers in Montenegro in near future. In the process of defining this model, attention was also paid to geographic factor as well as the existing road network in the sense of maximum reduction of transportation costs.

For the purpose of starting the abovementioned activities as soon as possible, beside *feed-in tariffs* and action plan for biomass, it is necessary to provide credit instruments under favorable terms from adequate funds to the companies. The reason for this is that degree of profitability in wood fuel production is small (9–13% depending on fuel type) and companies in such conditions do not have the possibilities to finance expensive credits of commercial banks from their own savings.

Having in mind all abovementioned elements, in particular the positions of certain wood processing companies in the sense of concession size, available amounts of wood residue, already undertaken activities of wood processing companies or municipal authorities as well as the structure and number of facilities that entered the fuel conversion program, it is realistic to expect that the first practical implementation of wood fuels in Montenegro for the purpose of heating public facilities will be realized in Pljevlja.

CONCLUSIONS

Current situation regarding the usage of woody biomass in Montenegro can be assessed as unsatisfactory, primarily in the segment of using wood residue from forestry and wood processing. Existence of domestic raw material resources is a starting point for future development of woody biomass market in Montenegro. At the same time it is its strongest side so far. Increase of the needs for fuels from domestic market as well as the determination of the Government to increase usage of energy from renewable sources is an important element for the development of woody biomass market and its strong side. Presence and activities of certain international organizations and their determination and support to the conversion of fossil fuels to biomass fuels in public facility systems are so far the starting element for the development of woody biomass market in Montenegro. Also, neighboring countries (where the market of wood fuels is already in function for a longer or shorter period of time and where stakeholders from Montenegro can see examples of good practice) are surely an important element and one of the stimuli for increased usage of woody biomass in near future in Montenegro.

LITERATURE

[1] Feasibility Study on "Commercial Usage of Wood Residue as a Resource for Economic Development in North Montenegro", *Faculty of Forestry, Belgrade, 2007.*
[2] Fellings in 2008: *MONSTAT, Podgorica, 2009.*
[3] Forest Directorate, Internal reports, background and data for different years, *Podgorica, 2010.*
[4] Foreign trade, *MONSTAT. Podgorica, 2008.*
[5] Glavonjić B.: "Opportunities, challenges and current progress with developing woody biomass markets in Montenegro", *FODEMO, Podgorica, 2010.*
[6] Department for Energy Efficiency in the Ministry of Economics of Montenegro: Different reports and data, *Podgorica, 2010.*
[7] Internal reports and datas from wood processing companies in Montenegro, *2010.*
[8] Kovačević I.: "Renewable energy sources in Montenegro", ESTEC workshop "Energy trends in Montenegroi", *Podgorica, 2009.*
[9] Report on business operations of Montenegrin Electric Enterprise, *Nikšić, 2009.*
[10] Renewable Energy Resource of Republic of Montenegro, *CETMA, Italy, 2006.*
[11] Real Estate Directorate of Montenegro, Background for maps, *Podgorica, 2010.*
[12] Strategy of Energetic Development of the Republic of Montenegro to 2025, Ministry of Economics of the Republic of Montenegro, *Podgorica, 2006.*
[13] Strategy of Energy Efficiency of the Republic of Montenegro, Ministry of Economics of the Republic of Montenegro*, Podgorica 2005.*